

# (12) UK Patent Application (19) GB (11) 2 361 019 (13) A

(43) Date of A Publication 10.10.2001

(21) Application No 0108426.8

(22) Date of Filing 04.04.2001

(30) Priority Data

(31) 0008594

(32) 08.04.2000

(33) GB

(71) Applicant(s)

**PolyOil Limited**  
(Incorporated in the United Kingdom)  
Sonas House, 12c Clarendon Place, STIRLING,  
GK8 2QW, United Kingdom

(72) Inventor(s)

**Harry Whitelaw**

(74) Agent and/or Address for Service

**Kennedys**  
Floor 5, Queens House, GLASGOW, G1 2DT,  
United Kingdom

(51) INT CL<sup>7</sup>

**E21B 17/10**

(52) UK CL (Edition S )

**E1F FAC4 FAC5**

(56) Documents Cited

**GB 2347953 A GB 2329209 A GB 2275284 A**

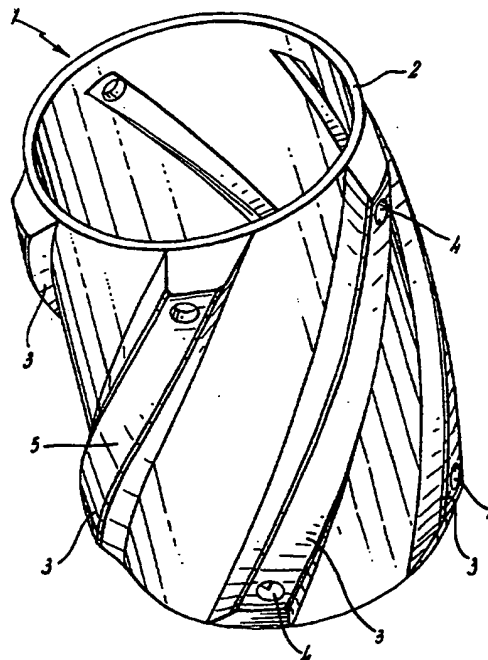
(58) Field of Search

**UK CL (Edition S ) E1F FAC**  
**INT CL<sup>7</sup> E21B 17/10**

(54) Abstract Title

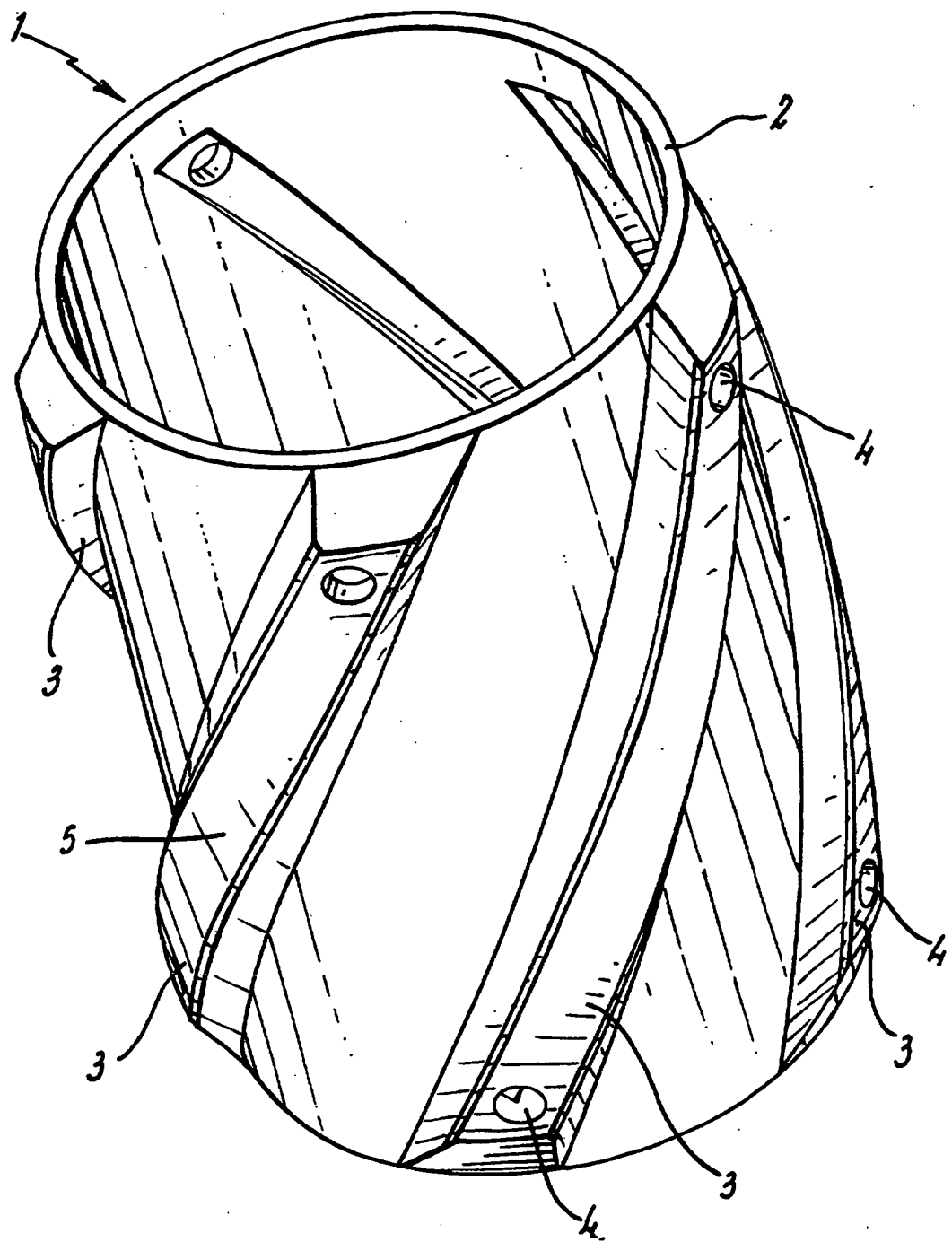
**Polyamide Casing Centraliser**

(57) A casing centraliser 1 comprises an annular body 2 with a plurality of ribs 3 extending longitudinally on the outer surface. A longitudinal bore extends through the annular body 2. The centraliser 1 is formed by casting a polyamide material, preferably using a monomer casting technique with centrifugal or gravity poured raw material. The ribs 3 may be hollow and contain ports 4 which allow the circulation of fluid through the ribs 3. Conduction means such as power lines or optical fibres may be contained within the ribs 3. The ribs 3 may also spherical members (8, fig 3) to reduce friction with the wellbore in use.



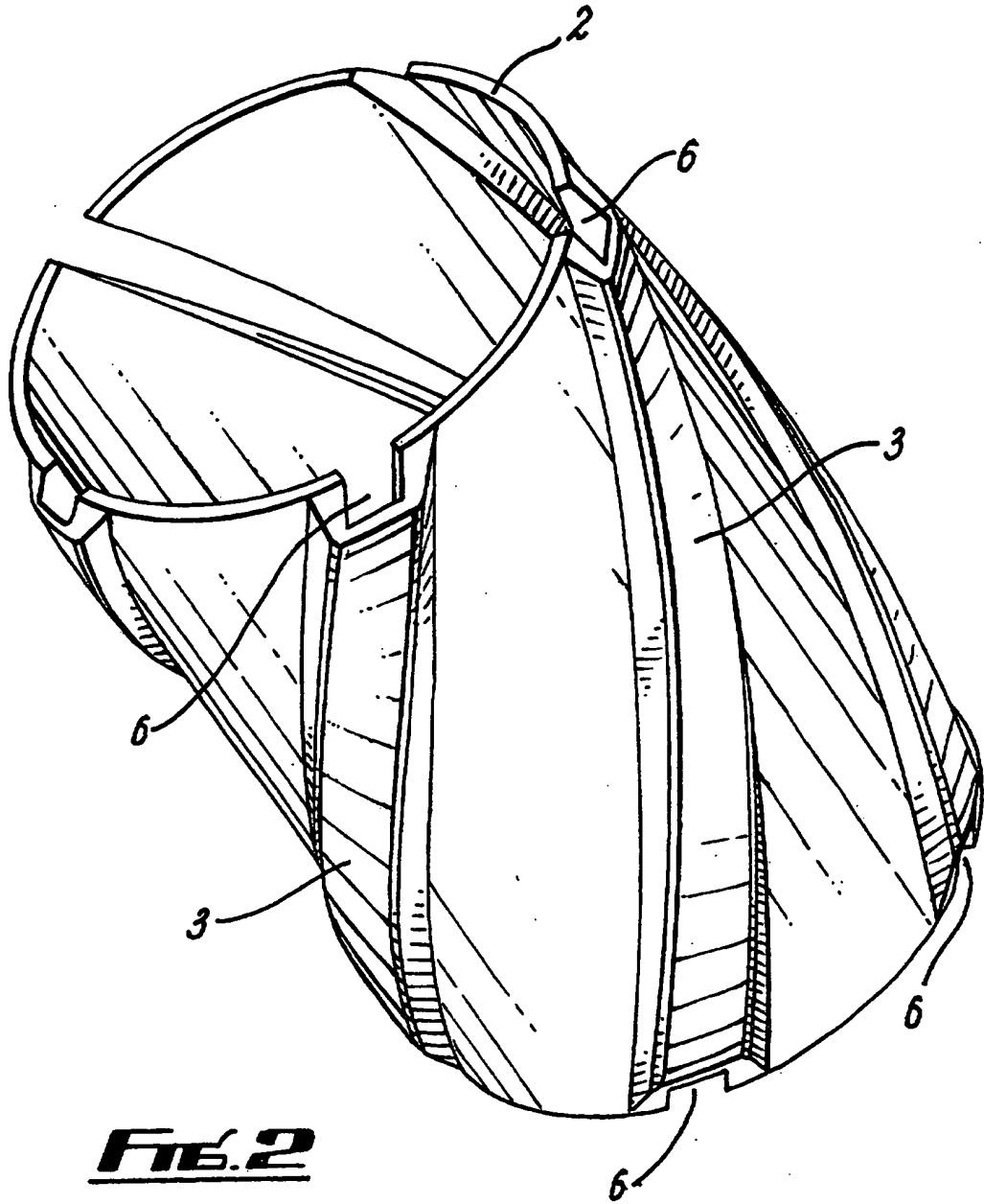
**FIG. 1**

1/3



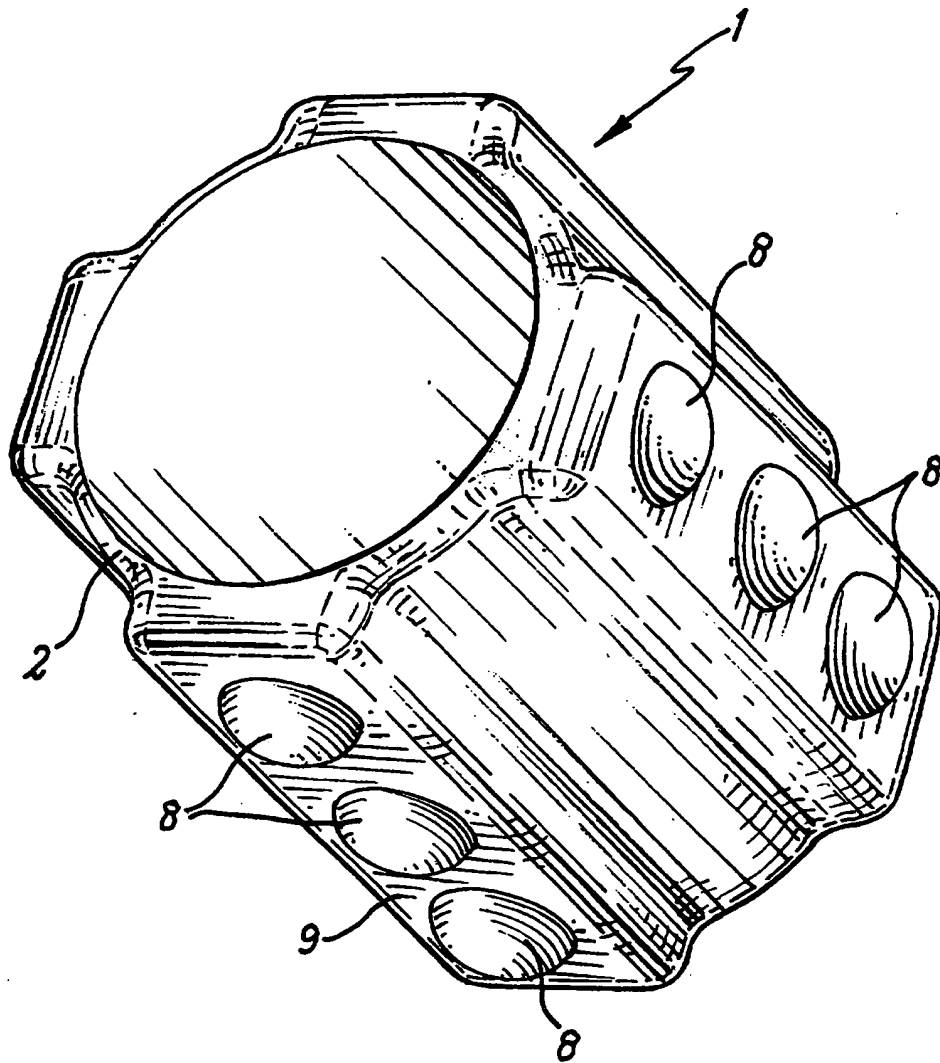
**Fig. 1**

2/3



**Fig. 2**

3/3



**Fig. 3**

1 IMPROVED CASING CENTRALISER

2

3 The present invention relates to centralisers as are  
4 typically for centering casing and to assist in the task  
5 of cementing casing in oil or gas wells, wherein the  
6 centraliser is made from a cast polymer material.

7

8 It is conventional practice after drilling an oil or gas  
9 well to run tubing, known as casing, into the well bore  
10 to act as a liner. The casing stabilises and prevents  
11 the bore from collapsing inwards. The casing is run into  
12 the newly formed bore from the surface, and the annular  
13 space between the casing and the bore is then filled with  
14 cement. Typically, cement is pumped to the bottom of the  
15 bore from where it is displaced into the annular space  
16 between the external surface of the casing and the  
17 interior of the well bore. The cement acts as a sealant  
18 and also to structurally support the casing in place.

19

20 It will be appreciated that before the casing is cemented  
21 in place, it is important that the casing is held  
22 substantially central within the bore. This allows a  
23 strong cement bond to be formed around the casing by

1 ensuring that an even thickness of cement is displaced  
2 around the casing. Ensuring that the casing is in a  
3 central position within the bore also prevents  
4 channelling of the cement or the creation of void spaces,  
5 as often occurs if the casing rests against the wall of  
6 the wellbore during the cementing procedure.

7

8 It is known in the art that fitting a centraliser to the  
9 casing will support the casing or liner off the well bore  
10 wall. It will be appreciated that providing standoff is  
11 particularly important as well bores are never truly  
12 vertical and often contain sharp bends and deviations in  
13 direction. Typically, one or more centralisers are  
14 mounted on the outside of the casing as it is lowered  
15 into the bore to centre the casing. The centralisers act  
16 to reduce friction and create standoff from the well bore  
17 which allows the casing to be rotated and cemented in a  
18 satisfactory manner.

19

20 There are several types of centraliser known to the art.  
21 One commonly used centraliser is the bow type, which  
22 comprises hollow cylindrical components or two axially  
23 spaced apart collars which are interconnected by spring  
24 bows. So called rigid or solid centralisers have a fixed  
25 outer diameter and are therefore less flexible than the  
26 spring bow type centraliser. It is common to include a  
27 number of 'blades' around the body of solid centralisers.  
28 These are typically raised solid structures which extend  
29 longitudinally around the centraliser body which engage  
30 the well bore wall and optimise standoff and therefore  
31 aid the centralising action of the tool.

32

1 It is also becoming more common to incorporate rollers on  
2 the body of centralisers to aid the rotation of the  
3 centraliser and therefore prevent "sticking" and also to  
4 reduce friction, torque and drag which are afforded to  
5 the centraliser as it contacts the wall of the well bore.  
6 Whilst these rollers reduce the resistance and torque  
7 afforded to the casing and centraliser, they are limited  
8 in efficiency as the rollers must be mounted on either a  
9 vertical or horizontal axis.

10

11 Conventionally, centralisers are made from a strong metal  
12 material. It will be appreciated that centralisers are  
13 subject to huge loads, such as impact and shear forces,  
14 and accordingly must be durable and hardy. However  
15 although metal centralisers are able to withstand high  
16 loads and the hostile downhole environment, they are not  
17 particularly flexible. This is a disadvantage if the  
18 centraliser encounters obstructions as it is run through  
19 the well bore on the casing. For example it is not  
20 uncommon for ridges or ledges to form in the wall of a  
21 bore during drilling, or for debris to accumulate in a  
22 section of the well. Metal centralisers are generally  
23 not flexible enough to yield to such obstructions, and  
24 therefore there is a risk that the progress of the casing  
25 procedure will be halted and that the casing upon which  
26 the centraliser is mounted will become stuck. A further  
27 problem of metal centralisers lies in the fact that they  
28 are prone to corrosion. This is a particular problem as  
29 acid is often pumped into well bores to stimulate and  
30 clean the well.

31

32 The most important criteria for any material to be used  
33 in the manufacture of centralisers is that the material

1 must be strong enough to withstand the shear forces and  
2 high loads which are afforded to a centraliser in use,  
3 but must also flexible enough to manoeuvre obstructions  
4 in the well bore and yield under extreme load. The use  
5 of plastic centralisers has been suggested for this  
6 purpose. Previous attempts to manufacture plastic  
7 centralisers have commonly relied on two manufacturing  
8 processes, namely injection moulding and extrusion.  
9 These involve physically changing processed raw material  
10 plastic "pellets". The pellets are heated to a suitable  
11 temperature such that they are malleable for extrusion  
12 and then ejected under pressure into the desired shape of  
13 a casing centraliser. However it has been found that  
14 plastic centralisers manufactured in this manner are  
15 restricted in their ability to withstand force. In  
16 addition the "pellets" which are produced by the chemical  
17 industry for extrusion and injection moulding have  
18 undergone several condensate and extrusion processes to  
19 deliberately thin viscosity to enable processing in  
20 standard machinery. The high pressures and chilling used  
21 in these processes induces an amorphous non-crystalline  
22 structure to be produced and causes further degradation  
23 of the material which detrimentally affects the final  
24 strength and wear resistance of the centraliser.

25

26 It is an object of the present invention to provide a  
27 casing centraliser which is hard wearing but has  
28 sufficient compliance and resilience to negotiate a  
29 restriction in the wall of a well bore. A linked aim is  
30 to provide a centraliser which does not corrode. In  
31 particular, in the present invention it is recognised  
32 that the method of manufacture previously used to produce  
33 plastic centralisers can be improved so as to produce



1 centralisers which have superior flexibility and  
2 durability. It has been found that the described method  
3 is best carried out using polyamide material.

4

5 It a further object of the present invention to provide a  
6 casing centraliser which has superior means for reducing  
7 torque and friction afforded to the centraliser as it is  
8 advanced downhole. In particular it is an object of the  
9 present invention to provide a centraliser which has  
10 sufficient compliance and resilience to negotiate any  
11 unplanned restrictions in the well bore.

12

13 According to the present invention there is provided a  
14 centraliser for mounting on casing comprising an annular  
15 body having a plurality of blades around said annular  
16 body, and a longitudinal bore extending through the  
17 annular body, characterised in that the annular body is a  
18 cast polyamide material.

19

20 Preferably the longitudinal bore makes a clearance fit  
21 around the casing on which the centraliser is attached.

22

23 Preferably the polyamide is nylon.

24

25 Preferably the plurality of blades are hollow.

26

27 Preferably each of the plurality of blades has a number  
28 of integral ports which allow the flow of fluid into, and  
29 out of the hollow blade.

30

31 Preferably the blades may contain conduction means.

32

33 Optionally the conduction means are power lines.

1

2 Alternatively the conduction means are optical fibres.

3

4 Optionally the blades extend parallel to the length of  
5 the annular body.

6

7 Alternatively the blades extend longitudinally and  
8 helically around the annular body.

9

10 Preferably the blades are shaped in such a manner that  
11 they are separated by void areas which define a flow path  
12 which permits the relative by pass of fluid between each  
13 of the blades.

14

15 Optionally the annular body is rotatably mounted on the  
16 casing.

17

18 Preferably the centraliser has low friction means.

19

20 Most preferably said low friction means are ball  
21 bearings.

22

23 Preferably said ball bearings are mounted on a racer.

24

25 Preferably said ball bearings are mounted on the blades  
26 of the annular body.

27

28 Preferably the centraliser has connection means for  
29 mounting the centraliser on the casing.

30

31 Most preferably said connection means are threaded end  
32 connections which mate with the casing.

33

1 Preferably the centraliser has an internal diameter which  
2 is at least equal to, or greater than the diameter of the  
3 casing on which the centraliser is mounted.

4

5 Preferably the dimensions of the centraliser are not  
6 limited and could be adapted to be suitable for use with  
7 any size of casing.

8

9 According to a second aspect of the present invention  
10 there is provided a method of manufacturing a cast  
11 polyamide centraliser wherein a liquid polyamide is cast  
12 into an annular shaped body by monomer casting.

13

14 Optionally the polyamide centraliser is cast by  
15 centrifugally casting a liquid polyamide material.

16

17 Alternatively the polyamide centraliser is cast by  
18 gravity pouring a liquid polyamide material.

19

20 Preferably the liquid polyamide is directly polymerised  
21 to a solid.

22

23 Preferably the annular shaped body has a number of ball  
24 bearings.

25

26 Preferably said ball bearings are made from polyamide  
27 material.

28

29 Most preferably said ball bearings and annular body are  
30 manufactured in one procedure.

31

1 An example embodiment of the invention will now be  
2 illustrated with reference to the following Figures in  
3 which:

4

5 Figure 1 illustrates a cast polyamide centraliser in  
6 accordance with the present invention;  
7 Figure 2 illustrates a cast polyamide centraliser with an  
8 alternative port configuration; and  
9 Figure 3 illustrates a cast polyamide centraliser with  
10 friction reducing means.

11

12 Referring firstly to Figure 1 a cast polyamide  
13 centraliser is generally depicted at 1 and comprises a  
14 polyamide annular body 2, which is essentially  
15 cylindrical and hollow and which can be mounted onto a  
16 casing string (not shown). The polyamide used may be  
17 nylon. The annular body 2 is at least the same size as  
18 the casing it is to be attached to and makes a tight fit  
19 around the casing (not shown). The annular body may be  
20 able to rotate or may remain stationary relative to the  
21 casing. The annular body 2 has a plurality of raised  
22 blades 3 which extend longitudinally and helically around  
23 the annular body 2. The blades are also produced from a  
24 polyamide material, typically the same polyamide as the  
25 annular body 2. The blades 3 provide maximum standoff  
26 when the centraliser 1 is in position on a casing or  
27 liner (not shown) in a well bore. Although the blades  
28 illustrated in Figure 1 extend longitudinally and  
29 helically around the annular body 2 it will be  
30 appreciated that in an alternative embodiment the blades  
31 may extend longitudinally and parallel to the annular  
32 body 2. An advantage of the present invention is that the  
33 blades 3 are hollow and have a number of ports 4 into and

1 out of which fluid can flow. The fluid may include  
2 drilling fluid, cleaning fluid, carrier fluids or gels  
3 used for gravel packing operations such as are  
4 continuously passed through the section of well being  
5 bored to lubricate the drilling apparatus and wash out  
6 the bore. The ports 4 may be positioned on the wall  
7 facing surface 5 of the blades or, in an alternative  
8 embodiment shown in Figure 2, may be located at the ends  
9 of the blade 6. Because the blades are hollow, they may  
10 be used as a conduit or housing to protect conduction  
11 means such as power lines, electrical cables or optical  
12 fibres. A further advantage is that the plastic hollow  
13 blades have a greater flexibility and compliance than  
14 convention metal solid blades and can therefore negotiate  
15 any obstructions countered in the wall of the bore.

16  
17 The advantage of the present invention over the prior art  
18 is that the polyamide material offers a substantially  
19 lower co-efficient to friction whilst being run in the  
20 well, and has superior compliance and resilience to metal  
21 centraliser. The polyamide centraliser also has superior  
22 ability to yield to any obstructions met in the path of  
23 the casing, over metallic centralisers.

24  
25 An important aspect of the present invention is the  
26 process by which the plastic centraliser is produced.  
27 Previous attempts to produce a plastic centraliser have  
28 used extrusion techniques or injection moulding with pre  
29 processed raw material plastic pellets. However it is  
30 generally recognised that such plastic centralisers are  
31 less efficient at withstanding the huge loads and impacts  
32 encountered in the downhole environment. In the present  
33 invention, monomer casting is used to produce a superior

1 and more efficient plastic centraliser. In the present  
2 invention it is also recognised that the described  
3 manufacturing process is best carried out using a  
4 polyamide material. The monomer casting is carried out  
5 using three lactams, namely caprolactum, capryllactam and  
6 laurinlactum along with catalysts and activators. The  
7 polyamide produced by monomer casting has a greater  
8 crystalline structure, superior viscosity and greater  
9 molecular weight than injected or extrusion materials.  
10 The polyamide therefore has an increased strength and  
11 wear resistance and is better suited to withstand the  
12 torque and drag afforded to a centraliser in the downhole  
13 environment. The castings may be produced from  
14 centrifugal casting, or gravity pouring for greater  
15 density. The cast polyamide manufactured by this process  
16 can also survive higher temperatures and pressures. A  
17 particular advantage of this manufacturing process lies  
18 in the fact that in order to monomer cast the polyamide  
19 centraliser, a liquid polyamide has to be used. This is  
20 in contrast to earlier attempts to produce a plastic  
21 centraliser which used pre-processed plastic "pellets".  
22 Therefore in the present invention, the manufacturing  
23 costs are reduced as there is no requirement for pre-  
24 processing the material, and the polyamide is directly  
25 polymerised from a liquid chemical form to a solid object  
26 in its mould.

27

28 Figure 3 illustrates a cast polyamide centraliser 1 which  
29 has a plurality of ball bearings 8 located on the  
30 externally facing surface of the annular body 2. In the  
31 depicted embodiment the ball bearings 8 are located on  
32 blades 9 which extend longitudinally and parallel to the  
33 annular body. The ball bearings 8 minimises the torque

1 and friction which is afforded to the annular body 2 of  
2 the centraliser, particularly when the centraliser is  
3 rotating, or is being rotated in the borehole or inside  
4 of a casing string. Most importantly, the ball bearings 8  
5 reduce the friction afforded in any direction on the tool  
6 1. This is in contrast to roller reamers which have been  
7 used in the past to reduce friction, but which can only  
8 be mounted on a vertical or horizontal axis and can  
9 therefore only minimise friction which is afforded in  
10 these directions. In one embodiment the ball bearings  
11 may be incorporated into the annular body 2 as a ball  
12 bearing racer which allows the ball bearings to 'race'  
13 around the outer circumference of the centraliser.

14

15 It is recognised in the present invention that the ball  
16 bearings may be manufactured from the same material as  
17 the annular body, that is polyamide and therefore the  
18 body 2 and blades 3, and the ball bearings 8 may be  
19 manufactured at the same time and as a whole.

20

21 The advantage of the present invention is that by using a  
22 casting process to manufacture a centraliser from a  
23 polyamide material, it has been found that a non-metallic  
24 centraliser can be produced which is durable, resilient  
25 and compliant and which does not have the inherent  
26 problems of conventional metal centralisers, notably the  
27 risk of corrosion, and low flexibility. Furthermore, the  
28 blades which allow optimum standoff of the centraliser  
29 from the well bore are hollow and therefore have  
30 increased flexibility and can be used to house power  
31 lines and other conduction means.

1 A further advantage is that the use of ball bearings in  
2 the present invention aids rotation of the centraliser  
3 and minimises friction in all directions.

4

5 The present invention is described for use on casing.  
6 However it is recognised that the centraliser may be  
7 adapted for use on any type of work string which is used  
8 in a downhole bore, such as liner, tubing or drill  
9 string.

10

11 An alternative production technique could be that of  
12 reaction moulding which is also a system of low pressure  
13 casting by polymerisation in the mould using catalysts in  
14 a similar manner to monomer casting, but with the  
15 advantages of more complicated and defined sections.

16

17 Further modifications and improvements may be  
18 incorporated without departing from the scope of the  
19 invention herein intended.



1 Claims:

2

3 1. A centraliser for mounting on casing comprising an  
4 annular body having a plurality of blades around  
5 said annular body, and a longitudinal bore extending  
6 through the annular body, characterised in that the  
7 annular body is a cast polyamide material.

8

9 2. A centraliser as claimed in Claim 1, wherein the  
10 longitudinal bore makes a clearance fit around the  
11 casing on which the centraliser is attached.

12

13 3. A centraliser as claimed in Claim 1 or Claim 2,  
14 wherein the polyamide is nylon.

15

16 4. A centraliser as claimed in any one of the preceding  
17 Claims, wherein the plurality of blades are hollow.

18

19 5. A centraliser as claimed in Claim 4, wherein each of  
20 the plurality of blades has one or more integral  
21 ports which allow the flow of fluid into, and out of  
22 the hollow blade.

23

24 6. A centraliser as claimed in any one of the preceding  
25 Claims, wherein the blades contain conduction means.

26

27 7. A centraliser as claimed in Claim 6, wherein the  
28 conduction means are power lines.

29

30 8. A centraliser as claimed in Claim 6, wherein the  
31 conduction means are optical fibres.

32

- 1 9. A centraliser as claimed in any one of the preceding  
2 Claims, wherein the blades extend parallel to the  
3 length of the annular body.  
4
- 5 10. A centraliser as claimed in any one of Claims 1 to  
6 8, wherein the blades extend longitudinally and  
7 helically around the annular body.  
8
- 9 11. A centraliser as claimed in any one of the preceding  
10 Claims, wherein the blades are shaped in such a  
11 manner that they are separated by void areas which  
12 define a flow path which permits the relative by  
13 pass of fluid between each of the blades.  
14
- 15 12. A centraliser as claimed in any one of the preceding  
16 Claims, wherein the annular body is rotatably  
17 mounted on the casing.  
18
- 19 13. A centraliser as claimed in any one of the preceding  
20 Claims, wherein centraliser has low friction means.  
21
- 22 14. A centraliser as claimed in Claim 13, wherein said  
23 low friction means are ball bearings.  
24
- 25 15. A centraliser as claimed in any one of the preceding  
26 Claims, having connection means for mounting the  
27 centraliser on the casing.  
28
- 29 16. A centraliser as claimed in Claim 15, wherein said  
30 connection means are threaded end connections which  
31 mate with the casing.  
32

- 1 17. A centraliser as claimed in Claim 15 or 16, wherein  
2 the centraliser has an internal diameter which is at  
3 least equal to, or greater than the diameter of the  
4 casing on which the centraliser is mounted.  
5
- 6 18. A method of manufacturing a cast polyamide  
7 centraliser wherein a liquid polyamide is cast into  
8 an annular shaped body by monomer casting.  
9
- 10 19. A method as claimed in Claim 18, wherein the  
11 polyamide centraliser is cast by centrifugally  
12 casting a liquid polyamide material.  
13
- 14 20. A method as claimed in Claim 18, wherein the  
15 polyamide centraliser is cast by gravity pouring a  
16 liquid polyamide material.  
17
- 18 21. A method as claimed in any one of Claims 18 to 20,  
19 wherein the liquid polyamide is directly polymerised  
20 to a solid.  
21
- 22 22. A method as claimed in any one of Claims 18 to 20,  
23 wherein the annular shaped body has a number of ball  
24 bearings, wherein said ball bearings are also made  
25 from polyamide material, and wherein the ball  
26 bearings and annular body are manufactured in one  
27 procedure.  
28  
29